Griffin + Lindig 1979

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Oviposition Cage and Auxiliary Equipment for Mass Rearing of Boll Weevils

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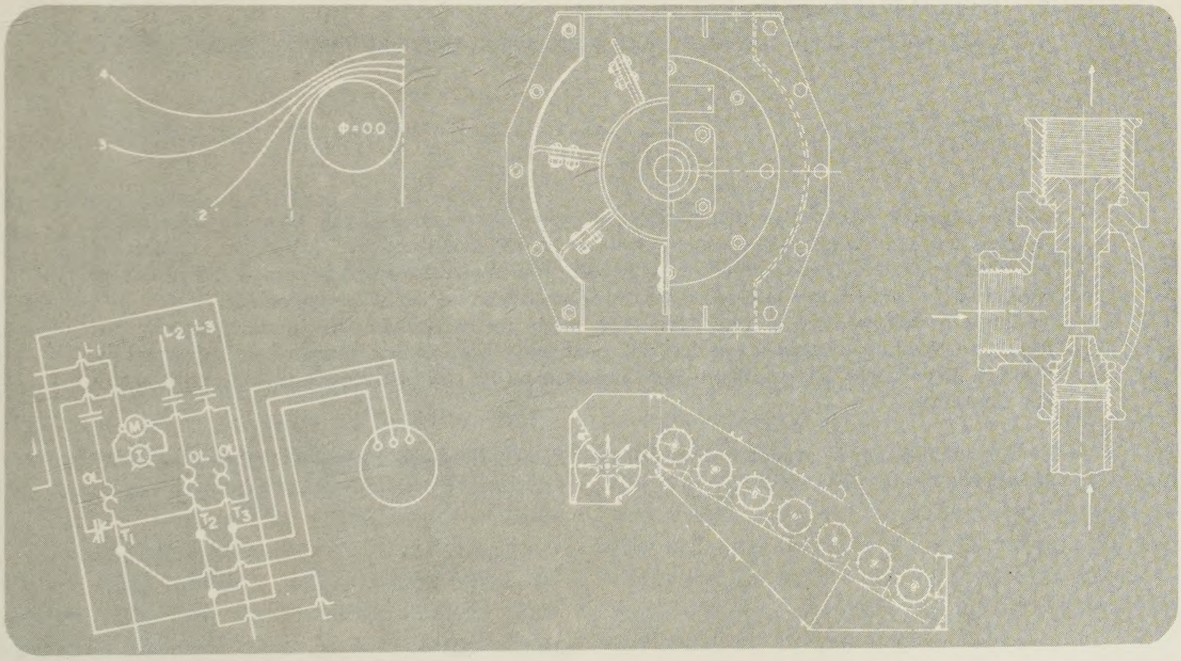

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Oviposition Cage and Auxiliary Equipment for Mass Rearing of Boll Weevils

By J. G. Griffin and O. H. Lindig[1]

ABSTRACT

Equipment was developed to reduce the time and labor required to handle and feed the large numbers of boll weevils used for egg production in a mass-rearing operation. The equipment, all of which can be handled by one person, consists of large oviposition cages, which accommodate 9,000 adult weevils each, a cage shaker, and a cage conveyor. The shaker simplifies changing the food pellets daily, and the conveyor holds and moves up to 150 oviposition cages at a time. One person can feed a cage of weevils in about 1 minute with the equipment. Index terms: *Anthonomus grandis* Boheman, insect-rearing equipment.

INTRODUCTION

During egg production in a mass-rearing operation, adult boll weevils, *Anthonomus grandis* Boheman, are held in oviposition cages. Descriptions of some cages used earlier for small- and medium-sized cultures of weevils are given by Gast and Davich (1966). A new oviposition cage and auxiliary equipment were developed to reduce the time and labor required to care for large numbers of weevils. The equipment was tested for use in a mass-rearing operation at the Robert T. Gast Rearing Laboratory, Mississippi State, Miss. The cage holds mixed sexes of adults and a supply of food pellets, which also serve as oviposition sites for the weevils (Griffin and Lindig 1974). The new cage is much larger than the earlier ones, but it can be easily handled by one person.

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EQUIPMENT

OVIPOSITION CAGE

The cage is 18 by 38 by 1¾ inches, and it consists of a base, a feed basket, and a lid (figs. 1 and 2). The lid is attached to the base but is readily detachable for cleaning and sanitizing.

The walls of the base are constructed of ½- by 1½-inch angles formed from 14-gage material with the ½-inch leg turned to the inside as part of the bottom. The bottom is covered with 12-mesh wire cloth. Four ½- by ⅜-inch by 24-gage angle ribs are attached across the frame bottom and to the wire cloth bottom to prevent sagging. A handle is spot-welded to each end of the base to aid handling of the cage.

The feed basket fits inside the base and is 17 3/16 by 37⅜ by 1 inch. The sidewalls are made of ½- by 1-inch angle formed from 14-gage material with the ½-inch leg turned to the inside to form the outside edge of the bottom of the basket. The bottom is covered with 4-mesh wire cloth, which is spot-welded to the ½-inch leg of the sidewall angles. Three round ribs installed across (side to

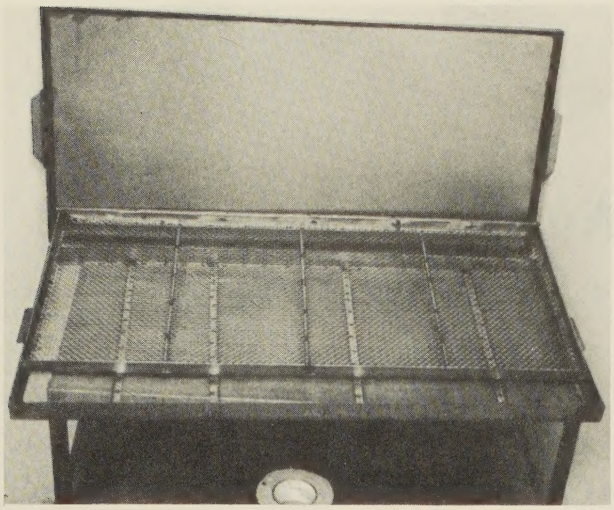


FIGURE 1.—Front view of oviposition cage.

side) the bottom and welded to the 4-mesh wire cloth prevent excessive sagging. A ⅜-inch rod tack-welded to the top front side of the basket serves as pivot or hinge pin on each end, support for the side of the basket, and a filler strip between the basket and the base. Four feet on the bottom of the back side of the basket serve as supports. A ¾-inch-diameter hook on the backwall of the basket is used for lifting this side of the basket to remove the pellets. The basket is easily removed for cleaning and sanitizing.

The lid, made of a ¾- by ¾-inch by 14-gage angle frame and a 24-gage stainless-steel cover, is hinged to the base with a pair of 2-inch slip hinges and is closed with a pair of toggle latches. A strip of 3/16- by ½-inch neoprene weatherstripping, bonded around the perimeter of the underside of the top cover, serves as a weevil-proof seal between the lid and base.

CAGE SHAKER

A cage shaker shakes the cage at feeding time to separate the weevils from the old pellets. The shaker consists of a base, a cage carriage, an eccentric drive and platform, and two pellet-holding bins (figs. 3 and 4). The base is constructed mainly of metal angle members, but it has a sheet-metal chute for directing the old pellets into holding bins, and an inclined metal shield for catching the debris that falls out of the cage bottom. A shelf near the bottom of the legs supports the holding bins. Metal plates and vibrator eliminator pads are attached to the bottom of the legs.

The cage carriage is 18½ by 38½ by 1¼ inches, and is constructed of 1¼- by 1¾- by ⅛-inch metal angles. It has four 1⅛-inch-diameter roller-bearing support wheels mounted on the bottom. These wheels roll on the side angles that form the top of the base. Two ¾-inch-diameter rods are placed across the carriage-frame angles to support the cage. A connection bracket for the eccentric drive arm is attached to the center of one end of the carriage frame. Notches are cut in the end frame angles of the carriage to make the handles on the cage more accessible when it is placed in or removed from the carriage.

The eccentric drive consists of a drive shaft with a ¼-inch offset, two ½-inch-bore and one 1-inch-bore pillow-block ball bearings, a drive arm with a connecting plate, and an electric motor with the necessary pulleys and belt. The middle section of the drive shaft is 1 inch, and the end sections are ½ inch in diameter. The 1-inch-bore bearing is mounted and fastened to the center section of the shaft and is free to move when the shaft turns. The ½-inch-bore bearings support the ½-inch-diameter section of shaft near the ends. One end of the drive arm is attached to a 3/16- by 2- by 5½-inch metal bar which is bolted to the base of the 1-inch-bore bearing block. The other end of the arm has a hole drilled in it and is attached to the carriage-connection bracket with a bolt. A 3-inch-diameter and 2-inch-wide balancing cylinder is attached to one end of the drive shaft, and a V-pulley is attached to the other end.

A metal frame platform with a plywood top supports the eccentric drive mechanism and motor. This platform is attached to the frame of the base with rubber mounts and bolts.

CAGE CONVEYOR

A Speed Check Conveyor Co. laundry-bundle conveyor with some modifications to the shelves is used to hold and convey the oviposition cages to and from the feeding station (fig. 4). This conveyor has 25 baskets, and each basket has shelves to accommodate 6 cages. Since the cages are 38 inches long and the depth of the shelves is only 21 inches, it was possible for the cages to become overbalanced and fall from the compartments. A ½-inch rod bent in a ⊔-shape was installed and extended along the sides of each shelf to increase the supporting depth of the shelves to 26 inches. Another ½-inch rod was installed about 4 inches from the back edge and 3 inches above each shelf

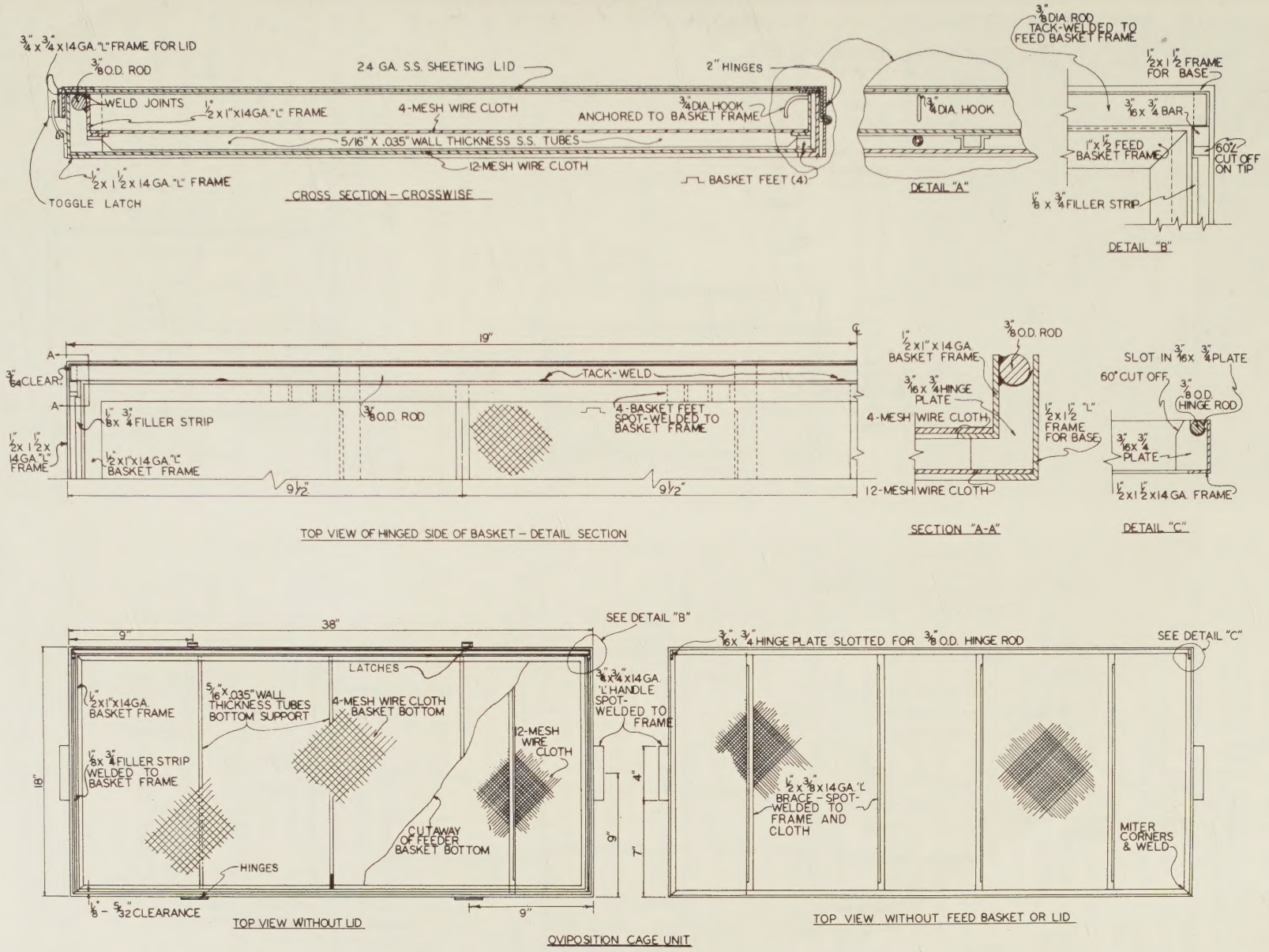
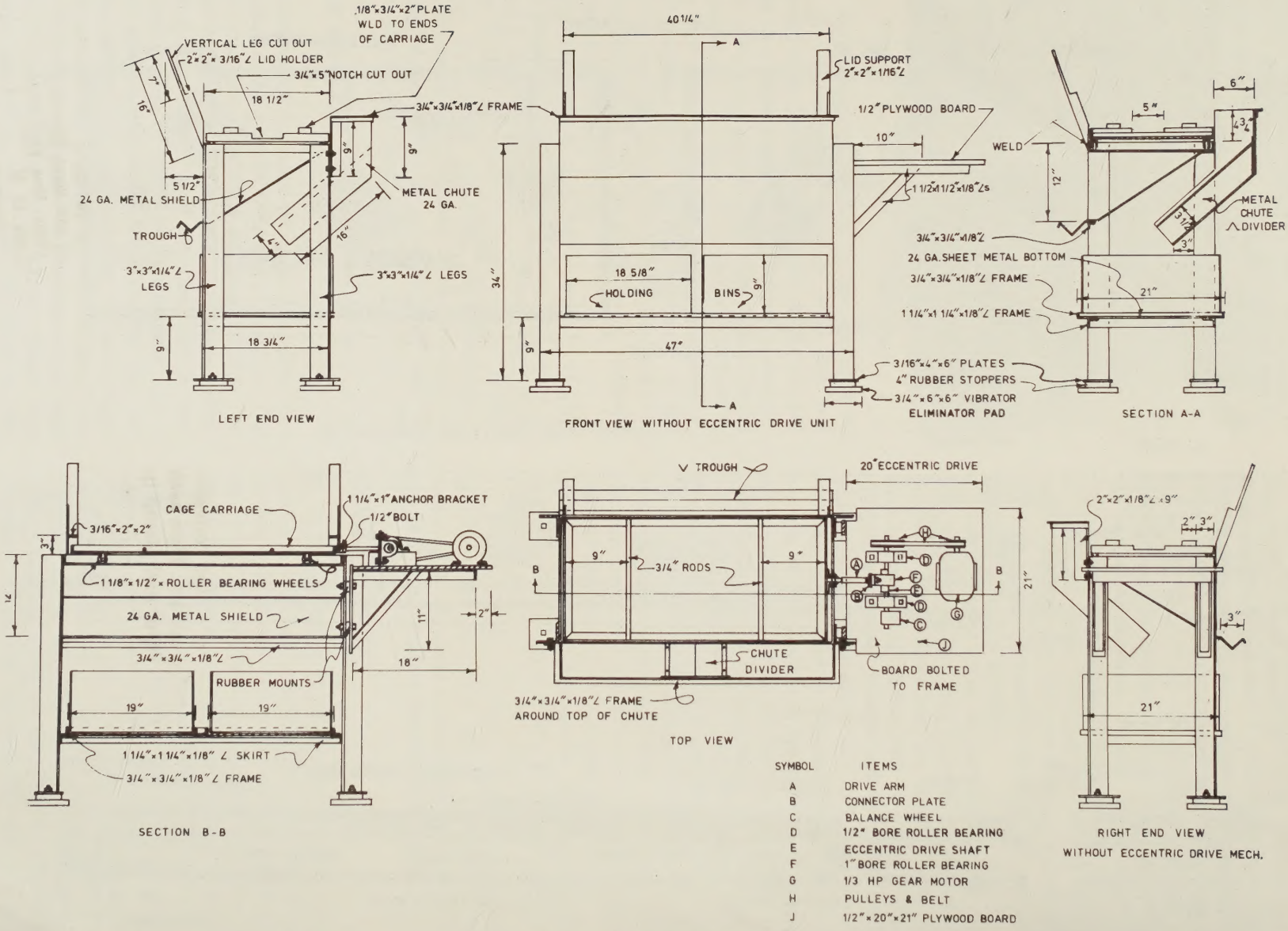

3/4" x 3/4" x 14 GA. "L" FRAME FOR LID
3/8" O.D. ROD
WELD JOINTS
1" x 1" x 14 GA. "L" FRAME
24 GA. S.S. SHEETING LID
4-MESH WIRE CLOTH
5/16" X .035" WALL THICKNESS S.S. TUBES
12-MESH WIRE CLOTH
1/2" x 1 1/2" x 14 GA. "L" FRAME
TOGGLE LATCH
CROSS SECTION - CROSSWISE
2" HINGES
3/4" DIA. HOOK
ANCHORED TO BASKET FRAME
BASKET FEET (4)
3/4" DIA. HOOK
DETAIL "A"
3/8" DIA. ROD
TACK-WELDED TO FEED BASKET FRAME
1" x 1 1/2" FRAME FOR BASE
3/16" x 3/4" BAR
1" x 1/2" FEED BASKET FRAME
60° CUT OFF ON TIP
1/8" x 3/4" FILLER STRIP
DETAIL "B"
19"
TACK-WELD
3/64" CLEAR
1/8" x 3/4" FILLER STRIP
1" x 1" x 14 GA. "L" FRAME
1/2" x 1" x 14 GA. "L" BASKET FRAME
3/8" O.D. ROD
4-BASKET FEET SPOT-WELDED TO BASKET FRAME
9 1/2"
9 1/2"
TOP VIEW OF HINGED SIDE OF BASKET - DETAIL SECTION
1/2" x 1" x 14 GA. BASKET FRAME
3/8" O.D. ROD
3/16" x 3/4" HINGE PLATE
4-MESH WIRE CLOTH
1" x 1 1/2" "L" FRAME FOR BASE
12-MESH WIRE CLOTH
SECTION "A-A"
SLOT IN 3/16" x 3/4" PLATE
60° CUT OFF
3/8" O.D. HINGE ROD
3/16" x 3/4" PLATE
1" x 1" x 14 GA. FRAME
DETAIL "C"
38"
9"
SEE DETAIL "B"
LATCHES
1" x 1" x 14 GA. BASKET FRAME
5/16" X .035" WALL THICKNESS TUBES BOTTOM SUPPORT
4-MESH WIRE CLOTH BASKET BOTTOM
3/16" x 3/4" x 14 GA. 'L' HANDLE SPOT-WELDED TO FRAME
12-MESH WIRE CLOTH
1/8" x 3/4" FILLER STRIP WELDED TO BASKET FRAME
18"
CUTAWAY OF FEEDER BASKET BOTTOM
HINGES
1/8" - 5/32" CLEARANCE
9"
TOP VIEW WITHOUT LID
3/16" x 3/4" HINGE PLATE SLOTTED FOR 3/8" O.D. HINGE ROD
SEE DETAIL "C"
4"
9"
7"
1/2" x 3/8" x 14 GA. 'L' BRACE - SPOT-WELDED TO FRAME AND CLOTH
MITER CORNERS & WELD
TOP VIEW WITHOUT FEED BASKET OR LID
OVIPOSITION CAGE UNIT

FIGURE 2.—Oviposition cage details.



SYMBOL	ITEMS
A	DRIVE ARM
B	CONNECTOR PLATE
C	BALANCE WHEEL
D	1/2" BORE ROLLER BEARING
E	ECCENTRIC DRIVE SHAFT
F	1" BORE ROLLER BEARING
G	1/3 HP GEAR MOTOR
H	PULLEYS & BELT
J	1/2" x 20" x 21" PLYWOOD BOARD

FIGURE 3.—Cage shaker details.

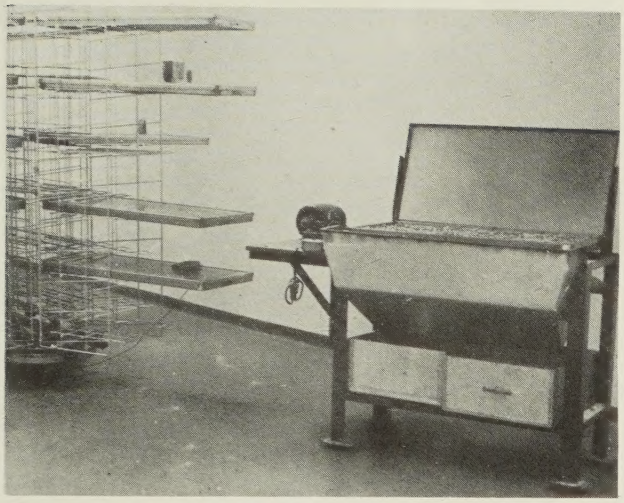


FIGURE 4.—Cage shaker, cage conveyor, and oviposition cages at feeding station.

to help prevent the cages from falling from the shelves. The construction of the baskets and shelves allows light to enter the bottom of the cages.

DISCUSSION

The wire cloth on the bottom of the cage provides light and ventilation and, to some extent, self-removal of some of the frass and other debris produced inside the cage. The 4-mesh wire cloth on the bottom of the feed basket retains the pellets but allows the weevils and smaller pieces of debris to fall from the basket to the bottom portion of the cage.

To prepare a cage with weevils, the lid is opened, fresh pellets are spread over the bottom of the feed basket and mixed sexes of newly emerged weevils are spread over the pellets. The lid is closed and fastened, and the cage is placed on one of the shelves of the conveyor. The weevils soon become adjusted to their new habitat and begin feeding on the pellets.

Once each day at feeding time, the conveyor moves the cages to the feeding station. Here each cage is removed from the conveyor and placed in the carriage of the shaker. The motor for the eccentric drive is turned on, causing the drive arm to move the carriage back and forth and shake the cage. This shaking causes the weevils to feign death and fall from the pellets or feed basket into the void between the bottoms of the feed basket and the cage. This separation of the weevils from the pellets is necessary to remove the old pellets, but not the weevils, from the cage. After shaking the cage for about 8 seconds, the motor is turned off. The cage lid is opened and leaned against the support. One side of the feed basket is elevated by lifting with the hook while the other side pivots on the ends of the rods fastened to the side of the basket. This dumps the old pellets from the cage and into the discharge chute to the holding bins while the weevils remain in the bottom of the cage. The basket is lowered to its original position, fresh pellets are spread over the bottom of the basket, the lid is closed and fastened, and the cage is placed back on the shelf of the conveyor. This procedure is repeated until all the cages of weevils are fed fresh pellets. A switch near the shaker unit operates the motor which drives the conveyor. Shaking the cage also causes most of the loose frass and other debris produced in the cage to fall through the bottom of the cage onto the inclined shield and into the trough from which it is removed at the end of the feeding operation. Magnetic and pneumatic vibrators were tested for shaking the cages, but they did not give as satisfactory results as the mechanical shaker.

All parts of the cage except the weatherstripping are made of stainless steel so that it can withstand cleaning and sanitizing agents. The cage lid and base must seal tightly, and the wire cloth covering the bottom of the cage must fit snug to the frame and be spot-welded properly at about ¾- to 1-inch intervals to eliminate puckers or openings from which the weevils might escape.

The new oviposition cage accommodates 9,000 weevils and is about as large as one person can comfortably handle. With the shaker unit, the weevils do not have to be removed from the pellets by hand. The cage handling and pellet exchange at feeding requires approximately 1 minute per cage. Therefore, a technician using the new equipment can handle five to six times more weevils without increasing time and labor or decreasing the quality of care.

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